

## AVIATION MECHANIC AIRFRAME TEST

### Section 2. Airframe Systems and Components

#### A. AIRCRAFT LANDING GEAR SYSTEMS.

Inspect, check, service, and repair landing gear, retraction systems, shock struts, brakes, wheels, tires, and steering systems.

—Level 3:

Determine aircraft tire inflation pressures.

The factors affecting the retreading of aircraft tires.

Adjust landing gear toe-in.

Install and remove aircraft wheel and brake assemblies.

Install tubes and tires.

Protect aircraft tires from hydraulic fluids.

Service brake boosters.

Service landing gear shock struts.

The effects of increasing temperature on “parked” brakes.

Determine the cause of an oleo strut bottoming during taxi operations.

The pressure source for actuating power brakes.

Select and install air valves in oleo shock struts.

Observe safety precautions when demounting tire and wheel assemblies.

Determine if a brake system requires bleeding; perform brake system bleeding.

Inspect and adjust multiple-disc brakes.

Install new linings in hydraulically operated single-disc brakes.

Determine the cause of spongy brake action.

Inspect and service aircraft tires and tubes.

Determine the reason for “dragging” brakes.

The method of equalizing braking pressure on both sides of the rotating disc of a single-disc brake.

Operate and check retractable landing gear.

Determine the cause of fading brakes.

Replace actuating cylinders.

Install brake blocks in an expander-tube brake assembly.

Inspect brake drums.

The purpose and function of metering pins in oleo shock struts.

Determine the cause of excessive brake pedal travel.

The operating principles of oleo shock struts during landing.

The storage requirements for aircraft tires and tubes.

The effect of a broken return spring in a brake master cylinder.

Determine the cause of grabbing brakes.

The purpose and operation of a booster in a hydraulic power brake system.

Detect internal leakage in a brake master cylinder.

The operating principles of servo, expander-tube, multiple-disc, and single-disc aircraft brakes.

The purpose and operating principles of brake master cylinders.

#### B. HYDRAULIC AND PNEUMATIC POWER SYSTEMS.

Repair hydraulic and pneumatic power system components.—Level 2:

Install packing seals and rings on hydraulic components.

Determine the correct seal type to use with ester-base, petroleum-base, and vegetable-base fluids.

Remove and install hydraulic selector valves.

Remove and install a spool-type or balanced-type pressure regulator.

Determine the cause of excessive oil in an aircraft pneumatic power system.

The operating principles of a pneumatic power system multistage reciprocating compressor.

Identify hydraulic seals and packings.

Protect packing rings or seals against thread damage during installation.

### **Identify and select hydraulic fluids.—**

#### **Level 3:**

Determine the fluid type for use in a specified aircraft hydraulic system.

The method of measuring the viscosity of a liquid.

Identify ester-base, petroleum-base, and vegetable-base fluids.

### **Inspect, check, service, troubleshoot, and repair hydraulic and pneumatic power systems.—Level 3:**

Determine the air pressure in a hydraulic accumulator.

The location and use of quick-disconnect fittings in hydraulic and pneumatic systems.

The mounting position of diaphragm and bladder-type hydraulic accumulators.

Service hydraulic reservoirs.

Determine the causes of incorrect system pressure.

Service porous paper and micronic filtering elements.

Adjust the pressure setting of the main system relief valve.

Purge air from a hydraulic system.

The term used to indicate force per unit area.

Identify the types of hydraulic power systems.

The purpose, location, and operation of a hydraulic fuse.

Protect a hydraulic system against contamination during a component replacement.

Inspect a hydraulic system for water and metal contamination.

Service a pneumatic system moisture separator.

The purpose, location, and operation of an orifice check valve in the wing flap actuating system.

The purpose, location, and operation of a wing flap overload valve.

The purpose, location, and operation of a hydraulic system pressure regulator.

The purpose, location, and operation of a sequence valve.

The purpose, location, and operation of a crossflow valve.

The purpose, location, and operation of a hydraulic system pressure accumulator.

The purpose, location, and operation of a shuttle valve.

The purpose, location, and operation of a check valve.

Install and remove engine-driven hydraulic pumps.

The indications of a worn or damaged hydraulic pump shaft.

The operating principles of hydraulic hand pumps.

The cause of hydraulic pump chatter during operation.

The operating principles of a constant-displacement hydraulic pump.

The operating principles of a variable-displacement hydraulic pump.

The purpose of the shear section on the shaft of an engine-driven hydraulic power pump.

The purpose and operation of a hydraulic actuating cylinder.

Determine the cause if a constant-pressure hydraulic system with no external leakage will not hold pressure when the power pump is not operating.

Determine the cause if an engine-driven power pump will not maintain system pressure during the actuation of a unit in the system.

The general features and operating principles of aircraft pneumatic power systems.

The purpose of pressurized reservoirs in some hydraulic systems.

The purpose and location of a standpipe in some hydraulic reservoirs.

The causes of too frequent cycling of a constant-pressure hydraulic system.

Operate and check a hydraulically operated flap system.

The operating mechanism of most hydraulic pressure gauges.

The indications of a low fluid supply during system operation.

### **C. CABIN ATMOSPHERE CONTROL SYSTEMS.**

**Repair heating, cooling, air-conditioning, pressurization, and oxygen system components.—Level 1:**

The usual reasons a surface combustion heater fails to operate.

The effects of cracks or holes in an exhaust-type heat exchanger.

The usual sources of contamination of a freon system.

The method of protecting a freon system from contamination during replacement of a component.

**Inspect, check, troubleshoot, service, and repair heating, cooling, air-conditioning, and pressurization systems.—Level 1:**

The operating principles of a thermostatically controlled surface combustion heater.

The methods used to control cabin pressure of a pressurized aircraft.

The protective features included in the control circuits of surface combustion heaters.

The purpose and operation of check valves in the delivery air ducts of a pressurization system.

The basic principles of providing and controlling aircraft pressurization.

The inspection requirements of cabin heating systems that utilize an exhaust heat exchanger as a source of heated air.

The method of checking a combustion heater fuel system for leaks.

The function of the condenser in a freon cooling system.

The function of the evaporator in a freon cooling system.

The function of an expansion valve in a freon cooling system.

The location, in relationship to each other, of the units in a freon cooling system.

The method of determining the liquid level in a vapor-cycle cooling system.

The procedure for servicing a vapor-cycle air-conditioning system that has lost all its freon charge.

The basic operating principles of an air-cycle cooling system.

The function of a jet pump in a pressurization and air-conditioning system.

The function of a mixing valve in an air-conditioning system.

The function of the negative pressure-relief valve in a pressurization system.

The function of the outflow valve in a pressurization system.

The function and principles of operation of an automatic cabin rate-of-climb control system.

**Inspect, check, troubleshoot, service and repair oxygen systems.—Level 2:**

Check oxygen system for leakage.

Service oxygen system with breathing oxygen.

Inspect a breathing oxygen system for contamination.

#### **D. AIRCRAFT INSTRUMENT SYSTEMS.**

**Inspect, check, service, troubleshoot, and repair heading, speed, altitude, time, attitude, temperature, pressure, and position indicating systems.—Level 1:**

The procedure for “swinging” an aircraft magnetic compass.

The methods used to test a static air system for leakage.

The significance of various types of marks on the face of an instrument.

The operating principles of a thermocouple temperature-indicating circuit.

The service requirements of instrument system filters.

The effect of a ruptured or disconnected static pressure line located inside a pressurized cabin.

##### **Install instruments.—Level 2:**

The installation and connection of shock-mounted vacuum instruments to their power system.

The types of hardware used to install instruments.

The application of operation markings to the glass face of an aircraft instrument.

The protection of instruments during handling.

The installation practices necessary to prevent damaging an instrument.

The installation practices used in making hose or tubing connections to the instruments.

#### **E. COMMUNICATION AND NAVIGATION SYSTEMS.**

**Inspect, check, and service autopilot and approach control systems.—Level 1:**

The operating principles of the sensing device used in an autopilot system.

The purpose and operation of the autopilot.

The purpose of a servomotor in an autopilot system.

The installation requirements for autopilot units.

The function of a position transmitter in an autopilot system.

**Inspect, check, and service aircraft electronic communication and navigation systems.—Level 1:**

The FCC regulations pertaining to the operation of two-way radio.

The principal conditions which must be considered in the installation of radio.

The protection of radio equipment from shock and vibration.

The methods of reducing engine noise in radio receivers.

**Inspect and repair antenna and electronic equipment installations.—Level 2:**

The preferred location and methods of mounting external antennas.

The procedure for returning an aircraft to service after a radio installation has been made in accordance with approved installation data.

The preferred location for the VOR localizer receiver antenna on a small aircraft.

#### **F. AIRCRAFT FUEL SYSTEMS.**

**Check and service fuel dump systems.—Level 1:**

The reasons for requiring fuel dump systems.

The methods used to control the operation of fuel dump chutes and valves.

The principal safety requirements for a fuel dump system.

The purpose of jettison pumps in fuel dump systems.

**Perform fuel management, transfer, and defueling.—Level 1:**

The precautions required when defueling an aircraft.

The tank-to-engine combinations possible with a crossfeed system.

The method of maintaining c.g. limits using fuel transfer technique.

The arrangement of fuel system controls, indicators, and warning lights.

**Inspect, check, and repair pressure fueling systems.—Level 1:**

The method of controlling fuel level during pressure fueling operations.

The methods used to operate fueling valves.

The protection of integral tanks against overpressure during pressure fueling operations.

The arrangement of fueling system controls, indicators, and warning lights.

The precautions required when fueling an aircraft.

The purpose and operation of pilot valves.

**Repair aircraft fuel system components.—Level 2:**

Repair and seal fuel tanks.

Pressure test fuel tanks.

Remove and clean fuel strainers.

The precautions to follow when routing fuel lines.

The method of regulating fuel system pressure.

**Inspect and repair fluid quantity indicating systems.—Level 2:**

The methods used to determine the level of fluid in a tank.

The purpose of remote-reading electrical gages.

Calibrate liquidometer-type fluid quantity indicating systems.

The effect of aircraft attitude on fluid level measuring devices.

**Troubleshoot, service, and repair fluid pressure and temperature warning systems.**

**—Level 2:**

Determine and adjust the pressure or temperature at which warning systems operate.

Determine the cause of incorrect warning system indications and make corrections.

Test the operation of temperature and pressure warning systems.

**Inspect, check, service, troubleshoot, and repair aircraft fuel systems.—Level 3:**

The fuel system inspection requirements for aircraft operating in areas of high humidity or wide temperature changes.

The design and installation requirements for aircraft fuel tanks.

The maintenance requirements of fuel tank sumps.

The marking requirements for fuel filler openings.

The purpose of potassium dichromate in a fuel system.

The reason for using booster pumps with engine-driven pumps.

The purpose of baffle plates in fuel tanks.

The installation and operation requirements of fuel valves.

The venting requirements of interconnected fuel tanks.

**G. AIRCRAFT ELECTRICAL SYSTEMS.**

**Repair aircraft electrical system components.—Level 2:**

Use a "growler" in generator and motor armature inspection and repair.

Check the condition of shunt and compound generator field circuits.

Locate and use overhaul information for electrical equipment.

The procedures for correcting generator brush arcing.

Dress or turn the commutator surface of a motor or generator armature.

Flash a generator field.

The effect of changes in speed and load on generator output.

The function of a commutator in a direct current electric motor.

Seat new or replacement generator brushes.

The effect of incorrect generator brush spring tension on generator operation.

The methods of reducing armature reaction in aircraft generators.

The operating principles of carbon-pile voltage regulators.

The design factors that determine the number of cycles-per-revolution an alternating current generator will produce.

Determine the speed (r.p.m.) of an electric motor.

The basic principles of generators.

The factors that affect the torque produced by an electric motor.

The methods used to protect armature shafts from overloads.

The speed and load characteristics of series-, compound-, and shunt-wound motors.

The means employed to control current and voltage output of aircraft generators.

The methods used to control output frequency and voltage of alternating current generators.

The general operating characteristics of vibrator-type current and voltage regulators.

The purpose and operation of reverse-current cutout relays in generator control circuits.

The basic internal electrical circuits of series-, compound-, and shunt-wound generators.

The operating principles of magnetic clutches and brakes commonly used with electric motors.

The purpose and operation of reversible electric motors.

### **Install, check, and service airframe electrical wiring, controls, switches, indicators, and protective devices.—Level 3:**

The purpose, applicability, and operation of electrical fuses and circuit breakers.

The types and operation of electrical switches.

Install and wire electrical switches.

Splice wiring in aircraft electrical systems.

The characteristics of high-tension and low-tension electrical wiring.

The purpose, applicability, and use of electrical wiring terminal strips.

The criteria for selecting aluminum and copper electrical cables.

Replace terminals on aircraft aluminum and copper electrical cables.

Determine the current-carrying capacity of an electrical circuit.

The installation and maintenance of open wiring electrical systems.

Install electrical wiring in conduits.

The method of protecting electrically operated emergency systems from accidental actuation.

The strength requirements for electrical cable terminals.

Select and install electrical bonding jumpers.

The installation requirements for electrical junction boxes.

The characteristics of single-wire electrical systems.

The special requirements an electrical bonding jumper must meet if it is required to carry a ground load for a unit of electrical equipment.

The purpose of shielding electrical wiring and equipment.

The use of quick-disconnect electrical plugs and sockets.

The purpose of static wicks or dischargers.

The American Wire Gage (A.W.G.) system of designating electrical wire sizes.

**Inspect, check, troubleshoot, service, and repair alternating current and direct current electrical systems.—Level 3:**

The results of short or open circuits in a generator control circuit.

The effect of sticking points in a reverse-current cutout relay.

The cause and effect of solenoid switch chatter.

The installation and circuit requirements for anticollision light systems.

The installation and circuit requirements for position lights.

The method of providing direct current for battery charging on aircraft that operate only alternating current generators.

The common methods of controlling output current and voltage of compound direct current generators.

The operating principles and characteristics of inverters.

Determine the output frequency of an alternating current generator.

The operating principles and characteristics of rectifiers.

The method of providing alternating current in aircraft that operate only direct current generators.

The electrical device usually used to convert alternating current to a lower or higher voltage without a change in frequency.

The operating principles and characteristics of electrical induction coils.

The operating principles and characteristics of transformers.

The advantages of using alternating current in aircraft.

## **H. POSITION AND WARNING SYSTEMS.**

**Inspect, check, and service speed- and takeoff-warning systems, electrical brake controls, and antiskid systems.—Level 1:**

The general requirements for installing skid detectors.

The operating principles of hydraulic brake antiskid systems.

**Inspect, check, troubleshoot, service, and repair landing gear position indicating and warning systems.—Level 3:**

Determine the cause of a gear unsafe warning signal.

The effect of various electrical faults in the operation of the landing gear warning system.

## **I. ICE AND RAIN CONTROL SYSTEMS.**

**Inspect, check, troubleshoot, service, and repair airframe ice and rain control systems.—Level 2:**

Install deicer boots.

The operating principles of anti-icing systems that utilize heated air in the leading edges of airfoils and intake ducts.

The operating principles of electrically operated anti-icing systems.

Protect deicer boots from deterioration.

## **J. FIRE PROTECTION SYSTEMS.**

**Inspect, check, and service smoke and carbon monoxide detection systems.—Level 1:**

The operating principles of smoke and carbon monoxide detection systems.

**Inspect, check, service, troubleshoot, and repair aircraft fire detection and extinguishing systems.—Level 3:**

The type of fire-extinguishing agent most suitable for use with electrical fires.

The fire-extinguishing agent normally used with built-in aircraft fire-extinguishing systems.

Check fire extinguisher container pressure.

Check continuity and resistance of the electrical circuit.

Determine the cause for the system failing to function.

Check fire warning sensors or detectors for open or short circuits.

# AVIATION MECHANIC POWERPLANT TEST

## Section 1. Powerplant Theory and Maintenance

### A. RECIPROCATING ENGINES.

**Inspect and repair 14-cylinder or larger radial engine.—Level 1:**

The purpose and advantages of using propeller reduction gearing.

The characteristics of thrust bearings used in large radial engines.

The characteristics of crankshaft bearings used in large radial engines.

The construction characteristics of the crankshaft and rod assemblies for a two-row radial engine.

The loads acting on the power case and nose case of a large radial engine during various conditions of operation.

The methods of classifying reciprocating engines.

The factors that affect the volumetric efficiency of an engine.

Determine the cylinder firing order for various types of engines.

**Overhaul reciprocating engine.—Level 2:**

The purpose and operating principles of dynamic dampers used in aircraft engines.

The characteristics of various crankshaft designs.

The basic operating principles of four-stroke cycle engines.

The characteristics of various piston pin and knuckle pin retention devices.

The processes used to harden cylinder bores.

The purpose and applicability of choke-type or taper-ground cylinders.

The wear characteristics of engine cylinder walls.

The purpose of valve overlap in some engines.

The effects of various poppet-type valve face angles.

The characteristics of various types of valve operating mechanisms.

The operating characteristics of zero-lash hydraulic valve lifters.

Time engine valves during engine assembly.

Install valve guides.

Grind and resurface valves and valve seats.

The purpose of using relatively large piston-to-cylinder wall clearances in aircraft engines.

The indications of failed or failing engine bearings.

The result of operating an engine at high power settings before the lubricating oil has come up to operating temperature.

Check piston rings for correct end and side clearance.

Check valve stems for stretch.

Repair a scored aluminum piston.

Perform crankshaft "runout."

Prepare engine for disassembly before overhaul.

Measure inside diameter, taper, and out-of-round of a cylinder bore.

Install cylinders and tighten holddown nuts.

The construction characteristics of air-cooled engine cylinders.

The construction characteristics and the operating principles of poppet-type engine valves.

The construction characteristics of aircraft engine pistons.

The types and arrangements of piston rings used in aircraft engines.

The purpose of using more than one spring on aircraft engine valves.

The operating principles and construction of spur and pinion-type and planetary-type propeller reduction gearing.

The principles of construction and operation of accessory gear drive trains on reciprocating engines.

Inspect cast and forged engine crankcase assemblies.

Remove and install studs in engine crankcase and accessory sections.

**Inspect, check, service, and repair opposed and radial engines and reciprocating engine installations.—Level 3:**

Check and adjust engine valve clearances. Determine the speed and direction of rotation of the cam ring in various radial engines.

The effect of excessive or insufficient valve clearance on engine operation.

The relationship between operating valve clearance and cold valve clearance.

Perform cylinder compression tests.

Perform an ignition system operational check.

Determine the condition of cable-operated engine control systems.

Check and adjust engine idling speed and mixture.

Detect and determine the cause of a "cold" cylinder.

The purpose of establishing one or more critical ranges for certain engine-propeller combinations.

The operating indications of a worn or weak engine.

The effect of a leaking oil dilution valve on engine operation.

The effect of a low oil supply on engine operation.

The indications of a correctly functioning engine oil system.

The probable cause of oil being thrown out of the breather of a wet-sump engine.

Determine the source and cause of metallic particles found on the oil screen during engine inspection.

The effect of an unbalanced propeller on engine operation.

The power settings most desirable for protracted engine operation.

Dilute engine oil in preparation for cold weather starting operations.

The purpose and operating principles of engine dynamic suspension systems.

Install and time a magneto.

**Install, troubleshoot, and remove reciprocating engines.—Level 3:**

The effect of throttle position upon fuel-air mixture in the cylinders during starting.

Pre-oil an overhauled engine before starting.

Install air-cooled engine baffles.

The method of hoisting or lifting engines during removal and installation.

The effect of increased engine manifold pressure on master rod bearing load.

The effect of air density on engine power output.

The causes of engine backfire.

The basic operational sequence for increasing or reducing the power output of an engine equipped with a constant-speed propeller.

The factors that affect an engine's tendency to detonate.

The effect of induction system air leaks on engine operation.

The indications of a leaking primer system during engine operation.

The effect of exhaust back pressure on engine power output.

The result of incorrect fuel-air mixture adjustments.

The indication and effect of carburetor icing.

Operate and adjust mechanical push-pull control systems.

## **B. TURBINE ENGINES.**

### **Overhaul turbine engine.—Level 2:**

The relationship between rotor speed and total thrust of a turbine engine.

The relationship between turbine inlet temperature and thrust of a turbine engine.

The relationship between operating altitude and thrust of a turbine engine.

The operating characteristics of turbine engines equipped with two-spool or "split" compressors.

The operating characteristics of fan and bypass turbine engines.

The relative gas pressures in various portions of a turbine engine.

The function of the nozzle diaphragm in a turbine engine.

The function of the exhaust cone in a turbine engine.

The operating characteristics and types of combustion chambers.

Remove and install outer combustion-chamber case and liners.

The methods for disassembling compressor sections.

The function and location of fuel nozzles.

### **Inspect, check, service, and repair turbine engines and turbine engine installations.—Level 2:**

The principles of operation of thrust reversing systems used with turbine engines.

The advantages of a gas turbine geared to a propeller.

The types of compressors most commonly used in turbine engines.

The construction and operating characteristics of axial-flow compressors.

The advantages of the axial-flow compressor over the centrifugal compressor.

The function and location of the diffuser section.

The basic design of turbine blades.

The effect of high ambient temperatures on turbine engine operation.

The type failures to which turbine components are subject.

The results of excessive operating temperature.

### **Install, troubleshoot, and remove turbine engines.—Level 2:**

The operating principles of a turbine engine.

The effect of air density on the thrust of a turbine engine.

The effect of exhaust nozzle adjustments on turbine engine operation.

The method of controlling compressor surge.

The purpose and operation of fuel control devices.

The cause of hot spots on the outer combustion casing.

The method of insuring ignition in combustion chambers not equipped with igniter plugs.

Adjust turbine engine fuel controls.

## **C. ENGINE INSPECTION.**

### **Perform powerplant conformity and airworthiness inspections.—Level 3:**

Determine that applicable Airworthiness Directives are complied with.

Determine that the powerplant conforms with the applicable FAA Specification.

## **AVIATION MECHANIC POWERPLANT TEST**

### **Section 2. Powerplant Systems and Components**

#### **A. ENGINE INSTRUMENT SYSTEMS.**

**Troubleshoot, service, and repair fluid rate-of-flow indicating systems.—Level 2:**

The purpose and operating principles of a fuel-flow indicating system.

The relationship between fuel flow and the power output of an engine.

**Inspect, check, service, troubleshoot, and repair engine temperature, pressure, and r.p.m. indicating systems.—Level 3:**

The operating principles of thermocouple-type temperature indicating systems.

The effect of a broken or leaking manifold pressure gage line.

The purpose and operating principles of an exhaust gas analyzer system.

The purpose and operating principles of a manifold pressure indicating system.

The operating principles of engine oil temperature indicating systems.

Apply markings to the glass face of engine instruments.

Install tachometer drives.

Determine the reason for failure of an electric tachometer system.

The requirements for a carburetor air temperature indicating system.

Determine the reason for an off-scale reading of a ratiometer-type indicating system.

Determine the cause of erratic indications when using a thermocouple system.

The purpose and operating principles of fuel pressure warning systems.

The installation practices for thermocouple leads.

The operation and use of synchronous motors.

Measure the resistance of thermocouple leads.

Determine the cause of an inverse reading in a thermocouple temperature indicating system.

Identify the types and application of thermocouples used to indicate turbine engine temperatures.

#### **B. ENGINE FIRE PROTECTION SYSTEMS.**

**Inspect, check, service, troubleshoot, and repair engine fire detection and extinguishing systems.—Level 3:**

Check continuity and resistance of the electrical circuit.

Determine the causes of system malfunction.

The methods used to release the extinguishing agent.

The sensing devices used in the detection systems.

#### **C. ENGINE ELECTRICAL SYSTEMS.**

**Repair engine electrical system components.—Level 2:**

Check the condition of shunt and compound generator field circuits.

Locate and use overhaul information for electrical equipment.

The procedures for correcting generator brush arcing.

Check a motor or generator armature to determine that the windings are not grounded.

Smooth the commutator surface of a motor or generator armature.

Determine the cause of solder deposits on the armature cover plate of a generator.

The purpose of a ripple filter in a generator power circuit.

The type of electric motor used with direct-cranking engine starters.

The types of voltage regulators used with high output direct current generators.

The results of short or open circuits in a generator control circuit.

The effect of sticking points in a reverse-current cutout relay.

The method of providing and controlling the field current of aircraft generators.

The methods of controlling parallel direct current generators.

The methods used to control output frequency and voltage of alternating current generators.

The methods of reducing armature reaction in aircraft generators.

The methods of controlling current and voltage output of compound direct current generators.

The operating principles of carbon-pile voltage regulators.

The operating characteristics of series-wound direct current electric motors.

The purpose and operation of reverse-current cutout relays in generator control circuits.

The general operating characteristics of vibrator-type current and voltage regulators.

Flash a generator field.

The effect of changes in speed and load on generator output.

The design factors that determine the number of cycles per revolution an alternating current generator will produce.

The factors that affect the torque produced by an electric motor.

The function of a commutator in a direct current electric motor.

Determine the output frequency of an alternating current generator.

The methods used to protect armature shafts from overloads.

Seat new or replacement generator brushes.

The effect of incorrect generator brush spring tension on generator operation.

The speed and load characteristics of series-, compound-, and shunt-wound electric motors.

The basic principles of electric generators.

The basic internal electrical circuits of series-, compound-, and shunt-wound generators.

The applicability and use of intermittent-duty electric motors.

The operating principles of magnetic clutches and brakes commonly used with electric motors.

The requirements and methods for controlling a malfunctioning generator.

The purpose and operation of reversible electric motors.

**Install, check, and service engine electrical wiring, controls, switches, indicators, and protective devices.—Level 3:**

The purpose, applicability, and operation of electrical fuses and circuit breakers.

The types of electrical switches and their operation.

Install and wire electrical switches.

Splice wiring in engine electrical systems.

The characteristics of high-tension and low-tension electrical wiring.

The purpose, applicability, and use of electrical wiring terminal strips.

The criteria for selecting aluminum and copper electrical cables.

Replace terminals on aircraft aluminum and copper electrical cables.

Types of switches and circuits used to control reversible electric motors.

- Identify aircraft electric cables.
- Determine the current-carrying capacity of an electrical circuit.
- Install electrical wiring in conduits.
- Use electric cable selection chart for determining the correct cable to use in specified circumstances.
- The strength requirements for electric cable terminals.
- Select and install electrical bonding jumpers.
- The installation requirements for electrical junction boxes.
- The installation and wiring of solenoid-operated switches.
- The characteristics of single-wire electrical systems.
- The use of quick-disconnect electrical plugs and sockets.
- The American Wire Gage (A.W.G) system of designating electrical wire sizes.
- The cause and effect of solenoid switch chatter.
- The method of providing direct current for battery charging on aircraft that operate only alternating current generators.
- The maximum permissible continuous load on the electrical system.
- The sources of alternating current power in aircraft that operate only direct current generators.
- The operating principles and characteristics of transformers.
- Determine the approximate continuous load on an aircraft electrical system.

#### **D. LUBRICATION SYSTEMS.**

##### **Identify and select lubricants.—Level 2:**

- The desirable characteristics for aircraft engine lubricating oils.
- The meaning and importance of oil viscosity.
- The meaning and significance of oil flash point.

The purpose of using synthetic lubricants for turbine engines.

The effect of heat on lubricants.

The grade designations for aviation oils.

The designations for synthetic turbine oil.

The results of operating an engine using an incorrect lubricant.

The functions of engine oil in addition to lubricating the engine.

##### **Repair engine lubrication system components.—Level 2:**

Clean and repair aluminum alloy external oil lines.

Clean external lubrication system components.

The function and location of an oil temperature regulator.

The size requirement for the oil inlet line.

Clean and test oil tanks.

The purpose and operation of the oil cooler.

The operating principles of lubrication pumps.

##### **Inspect, check, service, troubleshoot, and repair engine lubrication systems.—Level 3:**

Determine source and cause of metallic particles in the lubricating oil.

The purpose and principles of operation of engine oil dilution systems.

The expansion space requirements for engine oil supply tanks.

The purpose for changing engine lubricating oil at specified intervals.

The type of lubrication system generally used in high-volume reciprocating engines.

The factors that affect the oil consumption of a reciprocating engine.

The method normally used to prevent excessive oil from accumulating in the cylinders of inverted engines or the lower cylinders of radial engines.

The method of controlling the oil film on cylinder walls.

The method of lubricating the valve-operating mechanism in an overhead-valve engine.

The venting requirements of dry-sump and wet-sump engine lubrication systems.

The effect of broken or leaking lines in various parts of the lubrication system.

The effect of engine wear on the operation of the lubrication system.

The operating indications of a low engine oil supply.

The method of maintaining a reserve supply of oil in the engine oil supply tank for use in propeller feathering.

The requirements for marking oil tank fillers.

The purpose and operating principles of the lubrication system pressure-relief valve.

The purpose and operation of the oil cooler bypass valve.

The effect of congealed oil in the heat exchange portion of an oil radiator.

The purpose, location, and operation of anti-sludge chambers in the lubrication system of a reciprocating engine.

The purpose and operation of the bypass feature built into most engine oil filtering systems.

The operating principles of the stacked disc, edge filtration type of filter.

The characteristics and operating principles of dry-sump and wet-sump engine lubricating systems.

The purpose, location, and operation of the oil separator.

Adjust engine oil pressure.

The purpose of the restricted orifice in the oil pressure gage line.

The effect of obstructed rocker box inter-cylinder oil drain lines on engine operation.

The characteristics and principles of operation of a radial engine oil scavenging system.

## **E. IGNITION SYSTEMS.**

### **Overhaul magneto and ignition harness.— Level 2:**

The construction characteristics of magneto main case housings.

The characteristics and construction materials of magneto pole shoes or coil core extensions.

The purpose and methods of ventilating aircraft magneto housings.

The materials used in the construction of magneto breaker points.

The purpose and use of "keepers" placed across the poles of a rotating magnet that has been removed from a magneto.

Check the strength of a rotating magnet installed in a magneto.

Internally time a magneto during assembly.

Determine the rotational speed of a magneto when installed on various types of engines.

The purpose and location of condensers in a magneto electrical circuit.

Determine the condition of magneto breaker points by visual indications.

Lubricate a magneto breaker cam.

The effect of cam-follower wear on pivot- and pivotless-type breaker-point assemblies.

The meaning of the term "E-Gap Angle."

The characteristics of the rotating magnets commonly used in aircraft magnetos.

Install and adjust breaker points.

The characteristics of cams used in aircraft magnetos to operate the breaker points.

The purpose of setting ignition cables in a plastic insulating material within some ignition harnesses.

Install high-tension ignition cables in a shielded ignition manifold.

The purpose and operation of impulse couplings used with aircraft magnetos.

The results of operating a magneto with a broken impulse coupling spring.

The methods used to secure ignition leads in harnesses and distributor blocks.

Measure breaker point spring tension.

**Repair engine ignition system components.—Level 2:**

The purpose and operation of magneto breaker points.

Measure the capacity of a condenser.

Check ignition coil windings for shorts or open circuits.

Locate and use data associated with ignition system components.

The effect of weak magnets on engine operation.

The effect of weak breaker point spring tension on engine operation.

Clean and inspect spark plugs and igniter plugs.

Adjust spark plug electrodes.

The precautions to observe when working with high-energy ignition systems.

Determine that a distributor is internally timed.

The effect of high resistance in an ignition lead on engine operation.

The function and characteristics of ignition harnesses.

Determine the continuity of ignition wiring.

The construction and operation of a transformer coil for low-tension ignition systems.

**Inspect, check, service, troubleshoot, and repair reciprocating and turbine engine ignition systems.—Level 3:**

The purpose of shielding aircraft engine ignition systems.

The purpose and principles of staggered ignition timing.

Install and time an ignition system distributor.

Recognize and interpret basic ignition analyzer patterns.

The purpose and operating principles of spark advance systems.

The effect of using condensers of incorrect capacity in an ignition system.

The operating principles of low-tension ignition systems.

The effect a shorted primary winding in a low-tension ignition coil has on engine operation.

Install and test magneto ignition switches.

Test an ignition harness for electrical leakage.

The purpose and principles of compensated ignition timing.

The operating periods of turbine engine ignition systems.

The results of using a spark plug of incorrect heat range in an engine.

Install and remove spark plugs.

The meaning of "reach" as applied to spark plug design.

Inspect spark plugs for damaged insulation.

The cause and effect of various types of spark plug fouling.

The purpose and operation of an ignition booster system.

The purpose and operation of an induction vibrator.

Install and time a magneto equipped with an impulse coupling.

**F. FUEL METERING SYSTEMS.**

**Inspect, check, and service water injection systems.—Level 1:**

The purpose and effect of injecting water or water-alcohol during periods of high engine power output.

The means used to prevent the freezing of the water or ADI liquid.

The effect of atmospheric humidity on engine power when using water injection.

The effect of exhausting the water supply during takeoff operations utilizing water injection.

The purpose and effect of the derichment valve in the water-alcohol injection system.

The results of detonation within an engine.

The procedure to follow when detonation occurs.

The factor that determines the amount of water flow during ADI operation.

The method for preventing corrosion of lines and fittings used in ADI systems.

The purpose of the oil-pressure-operated valve in the ADI system.

#### **Overhaul carburetor.—Level 2:**

The fuel metering forces of a conventional float-type carburetor and a pressure-type carburetor.

The relationship between carburetor venturi size and engine displacement volume.

The fuel-air mixture requirements of an engine during idling and during high power settings.

The operation of the idling system of a float-type carburetor and a pressure-type carburetor.

The effect of a clogged main air bleed in a float-type carburetor on engine operation.

Check and adjust the float level of a float-type carburetor.

The effect of an incorrectly adjusted float level on engine operation.

The effect of a worn or grooved needle valve and seat assembly in a float-type carburetor on engine operation.

The operating principles of a back-suction-type mixture control.

The operating principles of an automatic mixture control.

The operating principles of economizer systems in float-type carburetors.

The effect of a ruptured diaphragm in a pressure-type carburetor on engine operation.

The basic function of a manual mixture control in an aircraft carburetor.

The location and operating principles of discharge nozzles used with pressure carburetors.

#### **Repair engine fuel metering system components.—Level 2:**

The operating principles of piston-type and single- and double-diaphragm acceleration pumps.

The operating principles of direct fuel injection systems.

The purpose and operation of a venturi.

The function of a metering jet.

The purpose of an air bleed in a carburetor.

The purpose of an economizer valve in a carburetor.

Clean carburetor parts.

Repair a leaking float.

The adjustments that may be made on a pressure-injection carburetor.

The effect of clogged impact tubes on engine operation.

The function of the synchronizer bar on fuel injection equipped engines.

The function and operation of the main and idling air bleed systems in a float-type carburetor.

#### **Inspect, check, service, troubleshoot, and repair reciprocating and turbine engine fuel metering systems.—Level 3:**

Adjust idling speed and mixture.

The principles of operation of an automatic fuel control unit used on a turbojet engine.

Trim turbojet engine fuel control system.

The effect of increased altitude on engine fuel-air mixture.

The relative burning rates of various fuel-air mixtures.

The fuel-air mixture requirements of a reciprocating engine at various power settings.

The operating characteristics of engines with direct cylinder fuel injection systems.

Install, remove, and adjust direct cylinder fuel injection system components.

The difference between a fuel injection system and a fuel injection carburetor.

The cause of lean mixtures in a conventional carburetor system.

The effect an inoperative vapor vent in a pressure-type carburetor has on engine operation.

The factors that affect the density of the air entering the carburetor.

## **G. ENGINE FUEL SYSTEMS.**

**Repair engine fuel system components.—**  
Level 2:

The types of engine-driven fuel pumps generally used with large reciprocating engines.

The purpose and operation of a fuel pump bypass valve.

The purpose and operation of fuel boost pumps.

**Inspect, check, service, troubleshoot, and repair engine fuel systems.—**Level 3:

The causes of fuel pressure fluctuation.

The characteristics of centrifugal-type fuel boost pumps.

The fuel system requirements for aircraft certificated in the "standard" classification.

The usual sources of aircraft fuel system contamination.

The purpose and requirements for strainers in fuel tank outlets.

Inspect aircraft fuel tank sumps and fuel strainers.

Adjust engine-driven fuel pump output pressure.

The location and operation of main fuel strainers.

The causes and effects of fuel system vapor lock.

The location and operation of fuel valves.

## **H. INDUCTION SYSTEMS.**

**Inspect, check, troubleshoot, service, and repair engine ice and rain control systems.—**  
Level 2:

The principles of alcohol injection to control induction system icing.

The effect of ice within the induction system on engine operation.

The operating principles of carburetor air heaters used to prevent or eliminate ice in an engine induction system.

The method used to prevent the entry of rain into the induction system of a reciprocating engine.

The operating principles of electrically heated inlet ducts.

The use of engine bleed air to control engine inlet icing.

The causes of carburetor and induction system icing.

**Inspect, check, service, and repair heat exchangers and superchargers.—**Level 2:

The effect of using heated air during periods of high engine power output.

The pressures present in various portions of the induction system of supercharged and unsupercharged reciprocating engines.

The principles of operation and control of turbosuperchargers.

The principles of operation and control of integral superchargers.

The purpose and operation of the induction system impeller used in some radial engines.

**Inspect, check, service, and repair carburetor air intake and induction manifolds.—**  
Level 3:

The position of the carburetor heat control during engine starting.

The purpose and location of the induction system screen in a reciprocating engine.

The purpose and location of the "hot spot" heater in the induction system of some reciprocating engines.

The installation and operation of a multi-point priming system on a radial engine.

The purpose, location, and servicing requirements for carburetor air filters.

The purpose and operation of ram air intake ducts on reciprocating engines.

## **I. ENGINE COOLING SYSTEMS.**

**Repair engine cooling system components.—Level 2:**

The attachment of cylinder head baffles.

The material used in the construction of air baffles.

Reprofile cylinder fins.

The effect of valve adjustment on the heat rejection rate of an engine.

**Inspect, check, troubleshoot, service, and repair engine cooling systems.—Level 3:**

The operating principles of the cooling system of vertically installed air-cooled helicopter engines.

The effects of excessive heat in an aircraft engine.

The purpose of fins on engine cylinders.

The effect of incorrectly installed baffles on engine operation.

The function and operation of cowl flaps.

The effect of fuel-air ratio on engine cooling.

The purpose and operation of cooling air augmenting systems.

The principles of "pressure baffling" used in cooling aircraft engines.

The precautions necessary during ground operation of aircraft engines.

## **J. ENGINE EXHAUST SYSTEMS.**

**Repair engine exhaust system components.—Level 2:**

The construction characteristics of exhaust augmentor tubes.

The materials used in exhaust system components.

The technique for cleaning ceramic-coated exhaust pipes.

Detect and repair cracks in stainless steel exhaust pipes.

The methods used to compensate for the unequal expansion rate of exhaust system components.

**Inspect, check, troubleshoot, service, and repair engine exhaust systems.—Level 3:**

Inspect exhaust systems that utilize an exhaust heat exchanger.

The purpose and operating principles of the turbines driven by the exhaust gases of a turbo-compound engine.

The function and location of exhaust augmenters.

The cause and effect of "frozen" ball joints in an exhaust system.

Clean and test exhaust-type heating mufflers.

The methods for torquing exhaust system clamps.

The purpose and construction of exhaust gas noise suppressors.

The effect of exhaust gas leakage on system components.

The purpose and operation of engine thrust reversers.

## **K. PROPELLERS.**

**Inspect, check, service, and repair propeller synchronizing and ice control systems.—Level 1:**

The purpose of slinger rings on some propeller installations.

The method of preventing ice formation on propeller spinners.

The operating principles of electrical de-icing systems for propellers.

The purpose of the governor step motor in the synchronizing system.

The purpose of propeller synchronizing systems.

The operating principles of synchronizing systems.

The operating principles of fluid anti-icing systems.

#### **Identify and select propeller lubricants.**

—Level 2:

The principal requirements for propeller lubricants.

The factors to be considered in selecting an oil or grease for a particular application.

#### **Balance propellers.—Level 2:**

The effects of propeller unbalance on engine operation.

Detect and correct vertical and horizontal unbalance in a two-blade propeller.

Balance a two-blade propeller that uses a separate hub for mounting on the engine crankshaft.

#### **Repair propeller control system components.—Level 2:**

Install oil control plugs in governors.

Use manufacturer's data to repair components.

The purpose and operation of a propeller governor.

The forces acting on a governor to produce speed control.

Determine the direction of rotation for which a propeller governor is set.

#### **Inspect, check, service, and repair fixed-pitch, constant-speed, and feathering propellers, and propeller governing systems.—Level 3:**

The purpose and function of the parts of a propeller.

The aerodynamic forces and loads acting on a rotating propeller blade.

The operating principles of propeller controls used with turbine engines.

The meaning and significance of "static limits" as related to the installation of a fixed-pitch propeller.

The purpose of the metal tipping on a wood propeller.

Measure propeller blade angle.

The meaning of propeller blade "back" and "face."

The method of making changes in the speed and power output of an engine equipped with a constant-speed propeller.

The operation of the distributor valve assembly of a hydromatic propeller.

The normal position of a constant-speed propeller control during takeoff.

The effect on engine operation of changing propeller pitch settings before a steady oil pressure is obtained after engine starting.

The meaning and significance of "critical ranges" established for some engine-propeller combinations.

The operation of a propeller during the feathering cycle.

The operation of a propeller during the reversing cycle.

The purpose of placing a propeller in a specified position prior to stopping the engine.

The relationship between blade position, airspeed, and angle of attack of the propeller blades.

The operating principles of two-position and constant-speed counterweight propellers.

The method of lubricating the pitch-changing mechanism of a hydromatic propeller.

The method of checking a steel propeller hub or blade for cracks.

The general procedure to be followed when using the chemical etching process to inspect aluminum alloy propeller blades.

Determine whether a bent aluminum alloy propeller blade can be repaired by cold straightening.

Clean and protect aluminum propeller blades.

The procedure for treating minor nicks and scratches on aluminum propeller blades.

Determine the blade pitch stop settings on a variable-pitch propeller.

The operating forces used to make blade pitch changes on various types of variable-pitch propellers.

The location and purpose of propeller blade cuffs.

**Install, troubleshoot, and remove propellers.—Level 3:**

Perform an operational check of propeller feathering system.

Detect and correct front and rear cone bottoming of a propeller installed on a splined crankshaft.

The purpose and use of snap rings on propeller installations.

The purpose and use of propeller cones in some propeller installations.

Determine the amount of contact between a tapered crankshaft and the propeller hub.

Install and track a fixed-pitch and constant-speed propeller.

Detect and correct looseness in a cable-operated propeller control system.

The most likely indications of a damaged piston-to-dome seal in a hydromatic propeller.

The most likely cause of oil leakage around the rear cone of a hydromatic propeller.

Perform an operational check of a propeller reversing system.

The constant-speed propeller setting used when checking ignition systems.

Adjust a propeller governor so that the propeller will operate within the correct range.

The purpose and significance of preloading the pitch-changing mechanism in a hydromatic propeller.